# SELF-CONTAINED ILLUMINATION DEVICE FOR MEDICINE CONTAINERS

## CROSS REFERENCES TO RELATED APPLICATIONS

Not applicable.

## BACKGROUND — FIELD OF INVENTION

The present invention relates to a self-contained illumination device for containers and more particularly pertains to permitting illumination of difficult-to-read medication labels in low-light environments with an illumination device for medicine containers.

## BACKGROUND — STATE OF THE ART

There are many occasions when an individual must wake from sleep, arise and take medications during the nighttime hours, when light levels are low. Medications, such as pain medicine, sleeping pills, antacids, migraine medicine, and medication that must be taken on timed schedules (e.g., four times per 24-hour period), among others, are often taken in the nighttime hours. Often, the individual requiring the medication has been asleep and thus is groggy and sometimes disoriented. The medication is generally contained in a medicine cabinet and/or a drawer in the bathroom, or in a

drawer near the individual's bed, along with many other medications (which are increasing every year as many new drugs become available, and as the population of the elderly increases). When combined, the above conditions, e.g., low light and/or no light, multiple medications in one location, pain and sleepiness, can increase the chances that the individual will take the wrong medicine or dosage.

One method for decreasing the chance of taking the wrong medicine is to provide light so that the individual can accurately read the medicine container label. The most often used method for achieving this is by turning on a light within the room (e.g., an overhead light in the bathroom or a desk lamp near the bed). This method has the disadvantage of causing further pain and disorientation, as the individual's pupils are most likely dilated due to the low-light level conditions and the sleep state. This method also has the undesirable affect of disrupting the sleep pattern of the individual, by bringing him closer to the state of awakeness, thus possibly further complicating the condition requiring the medication. Another less-used method for providing light is to use some type of hand-held light, such as a flashlight or book-reading light, to illuminate the medicine container. Due

to the direct, bright light of these devices, this method has similar problems as turning on a light, as discussed above. Additionally, this method is more difficult for the sleepy, groggy individual, as it requires two hands to examine the medicine container label and to open the container and retrieve the medicine. Further, flashlights and book-reading lights are often misplaced, have run-down batteries, and may not be in the correct location when needed. Finally, a nightlight may be used, but often these are not even available, or are situated away from the medicine container location (e.g., usually in an electrical outlet near the floor and/or near the toilet) and thus the patient must carry many medicine containers to the nightlight in order to retrieve the correct medicine. Again, this method is more difficult for the sleepy, groggy individual and offers the further danger of the individual falling and/or colliding with something in the pathway to the nightlight.

While these methods fulfill the objective of aiding the individual in retrieving the correct medication, it is obvious that they can exacerbate the original problem that caused the need for medication, or even cause further problems.

Therefore, from the above, it can be appreciated that there is a pressing and increasing need for a means to provide better illumination of medicine containers.

## SUMMARY OF THE INVENTION

The present invention is directed to improved containers for medicines, and in particular to improved illumination of medicine container labels to aid the individual in retrieving the correct medication in low-light level environments.

### Objects and Advantages

It is therefore an object of the invention to provide an illumination device for medicine containers, which prevents the possibility of an individual taking the wrong medication due to low-level lighting conditions.

It is another object of the invention to provide an illumination device for medicine containers, which illuminates the medicine container label in such a way, that the individual's eyes receive a minimum amount of direct light.

It is a further object of the invention to provide an illumination device for medicine containers, which illuminates

the medicine container label with a wavelength (color) and level of light intensity that does not cause the individual discomfort due to dilated pupils.

It is also an object of the invention to provide an illumination device for medicine containers, which may be easily and efficiently manufactured and marketed.

It is an additional object of the invention to provide an illumination device for medicine containers, which is of durable and reliable construction.

It is yet another object of the invention to provide an illumination device for medicine containers, which is waterproof.

It is yet a further object of the invention to provide an illumination device for medicine containers, which couples to a wide variety of types of medicine containers and/or medicine container caps used in the medical area.

It is yet an additional object of the invention to provide an illumination device for medicine containers, which is

adapted to a low cost of manufacture with regard to both materials and labor, thereby making the invention disposable or reusable, and which accordingly is then adapted for sale at low prices to the consuming public, thereby making such an illumination device for medicine containers economically available to the buying public.

In accord with these objects, which will be discussed in detail below, a self-contained illumination device for medicine containers is provided. The illumination device includes a light source component for illumination, a switch component to control the light source, supporting circuitry components to energize the light source, and a housing structure for: supporting and enclosing the components; directing the illumination to the label; and coupling the illumination device to a medicine container and/or a conventional medicine container cap. In a preferred embodiment, a light emitting diode (LED), emitting a bluish color, provides the illumination. An electrical switch is provided to connect an energy source to the LED thus turning it "ON." The light generated by the energized LED is further directed through a circular light-pipe channel within the device, which then directs it toward the label, thereby

illuminating the label in a 360-degree field. Supporting circuitry includes a battery with an electrical current-limiting potentiometer mounted on a printed circuit board (PCB). The housing structure is a molded plastic material containing a flexible material positioned directly over the switch, which allows the individual to activate the switch while also providing protection of internal components from the outside environment, e.g., a waterproof seal. Additionally, the housing structure provides the light-pipe channel; encapsulates the above components; and is designed to couple to a medicine container receptacle and/or a conventional medicine container cap.

The resultant self-contained illumination device for medicine containers is adapted for excellent illumination of medicine container labels in low-light level environments. An illumination device for medicine containers has application in the medical arts in the home environment for both humans and pets, unfamiliar locations (e.g., hotel rooms while traveling, camping, etc.), the clinical environment (hospitals and long-term care facilities), and in the pharmaceutical environment (pharmacies and/or pharmaceutical production laboratories); in the use of chemical handling in low-light level conditions,

such as in chemical laboratories and/or photography laboratories; and in the general home environment, for example, with spice containers, jars or household cleaners, in non-lighted cabinets or at night; among other fields.

There has been outlined, rather broadly, features of the invention in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter and which will form the subject matter of the claims appended hereto.

In this respect, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should

not be regarded as limiting.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Fig. 1 is a perspective view of the preferred embodiment of a medicine container with a container cap that illuminates a container label with light in a continuous 360-degree range;

Fig. 2 is a cross-sectional profile through the medicine container and container cap, taken on line 1—1 in Fig. 1, describing a side view of the functional components contained within the container cap;

Fig. 3 is a perspective view of a container cap insert cover, which retains a flexible membrane;

Fig. 4 is a circuit schematic of the preferred embodiment;

Fig. 5 is a cross-sectional profile of the flexible membrane.

Fig. 6 is a perspective view of a cylindrical adaptor used to connect the flexible membrane to an electrical switch.

Fig. 7 is a top plan view of the container cap of Fig. 1 showing the flexible membrane material and the container cap insert cover;

Fig. 8 is a top view of the functional components contained within the container cap of Fig. 2 with the container cap insert cover removed;

Fig. 9 is a bottom plan view of the container cap of Fig. 1 showing an annular output opening and functional components contained within the container cap;

Fig. 10 is a perspective view of a second embodiment of a medicine container with a container cap that illuminates the container label with visible light in a continuous 360-degree range using multiple LEDs;

Fig. 11 is a cross-sectional profile through the medicine container and container cap, taken on line 3—3 in Fig. 10, describing a side view of the functional components contained within the container cap;

Fig. 12 is a top plan view of the container cap of Fig. 10 showing the flexible membrane material and the container cap insert cover;

Fig. 13 is a top view of the functional components contained within the container cap of Figure 10 with the container cap insert cover removed;

Fig. 14 is a bottom plan view of the container cap of Fig. 10 showing four LEDs used for illumination;

Fig. 15 is a circuit schematic of the second embodiment;

Fig. 16 is a perspective view of a third embodiment of a medicine container with a container cap describing a flexible membrane material covering a side-mounted switch;

Fig. 17 is a perspective view of a fourth embodiment of a medicine container with a container cap describing a flexible container cap insert cover;

Fig. 18 is a block diagram of a fifth embodiment describing an additional circuit to control the LEDs used for illumination;

Fig. 19 is a block diagram of a sixth embodiment describing another circuit to control the LEDs used for illumination;

Fig. 20 is a block diagram of a seventh embodiment describing the combination of the circuitry shown in Figs. 18 and 19 used to control the LEDs used for illumination;

Fig. 21 is a side elevation view of an eighth embodiment of a medicine container with a container cap that is removably coupled to a conventional container cap and medicine container therewith;

Fig. 22 is an exploded, side elevation view of the embodiment shown in Fig. 21 describing the physical relationship between the container cap and the conventional container cap, and medicine container therewith, in the decoupled state;

Fig. 23 is a perspective view of a ninth embodiment of a medicine container with a container illumination base that is removably coupled to the medicine container therewith;

Fig. 24A is a top plan view of the container illumination base shown in Fig. 23;

Fig. 24B is a cross-sectional profile through the medicine container and container illumination base, taken on line 5—5 in Fig. 24A;

Fig. 25 is a perspective view of a tenth embodiment of a medicine container with an enclosing container illumination lightpipe that is removably coupled to the medicine container therewith; and

Fig. 26 is a cross-sectional profile through the medicine container and enclosing container illumination lightpipe, taken on line 7—7 in Fig. 25, describing a side view of the light source beam paths.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

With reference now to the drawings, FIGS. 1 through 9 illustrate a medicine container, generally **20**, embodying a container cap, generally **22**, and a container label **32** attached to a container receptacle **28** of the present invention. Container receptacle **28** includes a wall **25** with an outer surface **26**. Label **32** attaches to outer surface **26** and includes a set of instructional text **34**, or other indicia, which lists information about the patient and a medicinal product **30** contained in the container receptacle **28**, including product name, dosage instructions, expiration date, refill information, and/or other medicinal product information. This set of instructional text **34**, and identification of the medicinal product **30**, is the critical information the patient must read and recognize, respectively, in the low-light level environment. Additionally, label **32** may also be in the form of a small, peel-back instructional booklet, usually with very small print, which contains additional information regarding the medicinal product **30**. Other types of container labels **32** may exist as well and be illuminated by a plurality of light beams, generally **36**.

Container cap **22** is comprised of an inner annular support structure **74** having a central opening **75** into which is placed a printed circuit board **60**. Thus, printed circuit board **60** is contained within container cap **22** and is preferably positioned perpendicular to the longitudinal axis of the attached container receptacle **28**. Printed circuit board **60** is secured in central opening **75** to inner annular support structure **74** preferably by an adhesive **61**, such as AS-124M removable adhesive, available from Adhesives Research, Inc., although other securing methods may be used (e.g., bonding agents or mechanical fasteners). An outer annular support rim **70** contains an aperture ledge **71**, which accepts a container cap insert cover **24**. Container cap insert cover **24** is connected to outer annular support rim **70** at aperture ledge **71** by a frictional fit or by an adhesive, e.g., silicone rubber or AS-124M removable adhesive, available from Adhesives Research, Inc. Outer annular support rim **70** fits onto inner annular support structure **74** at an annular snap junction **82** to form a physical connection between the two (or outer annular support rim **70** can be attached to inner annular support structure **74** by an adhesive, such as silicone rubber). A plurality of anti-rotation pins **78** engage a plurality of anti-rotation pin

apertures **79**, located in outer annular support rim **70**, to keep outer annular support rim **70** from rotating as container cap **22** is tightened or removed. Inner annular support structure **74** is preferably fabricated by molding a clear or transparent plastic material, such as Acrylic or Lexan. Outer annular support rim **70** is preferably fabricated by molding an opaque plastic material, such as colored Acrylic or colored Lexan, or a moldable rubber material which provides additional gripping friction, such as GE Silicones liquid injection moldable rubber, LSR2005 elastomer. Additionally, inner annular support structure **74** and outer annular support rim **70** can be machined from plastic stock (e.g., cast Acrylic rod).

As seen in FIG. 3, container cap insert cover **24** is formed with an insert aperture **42** which accepts a flexible membrane **46**, preferably constructed from some type of rubber, e.g., silicone rubber, although any flexible material may be used. As seen in FIG. 5, flexible membrane **46** has a circumferential groove **54** with a tapered neck **38** just below groove **54**. When the flexible membrane **46** is inserted into container cap insert cover **24** with the tapered neck **38** projecting downwardly through insert aperture **42**, circumferential groove **54** engages insert aperture **42**. Additionally, flexible membrane lip,

generally **44**, seats against an insert ledge **50**, which is countersunk in container cap insert cover **24**, thus forming a smooth top surface for container cap **22**, that is, flexible membrane **46** does not protrude above container cap **22**. Flexible membrane **46** forms an environmentally protective barrier, e.g., waterproof, as well as making physical contact with an electrical switch **52**, e.g., a single-pole, single throw Panasonic EVQ-PLDA15, through a cylindrical adaptor **80**, containing a top surface **86**, which contacts flexible membrane **46**, and a bottom surface **90**, which contacts electrical switch **52** (FIG. 6). Cylindrical adaptor **80** is preferably manufactured from a clear Acrylic plastic, although different colored material may be used to change the final illumination color (discussed in more detail below). Container cap **22** also contains structure to produce a light pipe channel **72**, which is annular in shape in the preferred embodiment. The light pipe channel **72** has a lightwave entry end **67** and a lightwave exit end **68**. A lightwave **76**, generated by an illumination source **40**, e.g., a wide-angle, blue light emitting diode, such as a Lumex SSL-LX3044USBD, enters lightwave entry end **67** in a 360-degree direction (see FIGS. 2 and 8). Optionally, other LEDs, emitting other wavelengths (colors), or incandescent

bulbs, such as a Copeland retinoscope lamp bulb, may be used to generate lightwave **76**. Once inside light pipe channel **72**, lightwave **76** travels to lightwave exit end **68** and is emitted in a 360-degree direction.

Additionally, the outer surface, generally **84**, of the inner annular support structure **74** may be coated with a reflective coating, such as gold, silver or aluminum, or with multi-layer dielectric mirror coatings, to increase the internal reflection of lightwave **76** toward lightwave exit end **68**. Alternatively, the inner surface, generally **85**, of the outer annular support rim **70** may be coated with a reflective coating, such as gold, silver or aluminum, or with multi-layer dielectric mirror coatings, to increase the internal reflection of lightwave **76** toward lightwave exit end **68**. Lightwave exit end **68** is formed at a slight angle, e.g., 80-degrees from the longitudinal axis of attached container receptacle **28**, thus directing the light beams **36** more directly onto label **32**. Alternatively, lightwave exit end **68** can be formed with no angle, e.g., 90-degrees to the longitudinal axis of attached container receptacle **28**, while still providing adequate illumination of label **32**.

Lightwave **76** emerges from lightwave exit end **68** through an annular filter cover **62** to produce plurality of light beams **36**, generally at annular output opening **63**. Annular filter cover **62** may be clear, or may be manufactured with different colors depending on the color of the LED used. For example, annular filter cover **62** could be tinted, or constructed from a blue-colored material, such as an optical thermocast plastic color filter, available from Fosta-Tek Optics, or a Kodak Wratten filter (e.g., a Kodak 38A), and when used with a white LED, a blue illumination is produced at label **32**. There are a wide variety of LED/filter combinations that can be used to create many illumination colors. Annular filter cover **62** may also be constructed to simultaneously diffuse lightwave **76**. Additionally, as briefly discussed above, cylindrical adaptor **80** may be machined, or thermocasted, from a colored plastic material (available from Fosta-Tek Optics), and thus when used with a white LED, various illumination colors may be generated. Further, colored LED lens covers, e.g., a Chicago Miniature Lamp 434-6, can be used, which snap directly onto the LED itself, thus offering yet another method for achieving various illumination colors. Thus, there are a number of possibilities for creating various illumination colors.

Inner annular support structure **74** has a set of internal threads **64** for attachment to a set of external threads **66** in attached container receptacle **28**.

Printed circuit board **60** contains an energy source **56**, e.g., a silver oxide button-cell, such as a Duracell D361, which may be attached directly to printed circuit board **60**, or may be inserted in an energy source holder **57**, e.g., a Keystone model 500, thus making it replaceable, an electrical current-limiting device **48**, e.g., a Bourns Series 3309P potentiometer, the illumination source **40**, and the electrical switch **52**, all connected by PCB circuit traces in order to implement the closed circuit shown in FIG. 4. These circuit components can be inserted on printed circuit board **60** in an automated fashion (automatic insertion manufacturing typical to the electronics industry) or by manual methods. Alternatively, the closed circuit can be implemented by soldering the components together directly, without the use of the printed circuit board **60**, and subsequently securing, and containing, the components in central opening **75** by an encapsulating potting compound, e.g., EPOCAP 14530A/2404B, available from Sanford Distributing Co., or a flexible

adhesive, such as silicone rubber, e.g., Silastic® silicone rubber, available from Dow Corning.

In reading container label **32** and inspecting medicinal product **30** contained within container receptacle **28**, in accordance with the present invention using container cap **22** illustrated in FIGS. 1 through 9, the individual initially retrieves medicine container **20** from the appropriate location (medicine cabinet, medicine drawer, bedside drawer, etc.). Once in hand, the individual holds medicine container **20** in such a way that at least one digit of his hand, preferably his forefinger, rests on flexible membrane **46**. While reading container label **32**, the individual presses flexible membrane **46** thus contacting cylindrical adaptor **80**, which in turn contacts electrical switch **52**. As switch **52** closes, an electrical current **58** flows from energy source **56** through electrical current-limiting device **48**, and illumination source **40**, and eventually back to energy source **56**. As electrical current **58** flows through illumination source **40**, illumination source **40** is energized and lightwave **76** is emitted. Electrical current-limiting device **48** can be adjusted to vary the intensity of lightwave **76**. Since illumination source **40** is a

wide-angle LED, light will emerge in a 360-degree, radial direction toward the lightwave entry end **67** and into light pipe channel **72**. Lightwave **76** is directed by light pipe channel **72** through container cap **22** toward lightwave exit end **68**. Lightwave **76** then travels through annular filter cover **62** to become light beams **36**, which in turn illuminate container label **32**. The individual may then read container label **32**. On some medicine containers **20**, there is also instructional text on the back of the container. For this case, the individual simply rotates medicine container **20** and performs the preferably identical procedure described above. Additionally, the individual may use container cap **22** to illuminate medicinal product **30**. This can serve as an additional check that the individual is consuming the correct medicine. The individual would perform this function by removing container cap **22** from container receptacle **28**, retrieving medicinal product **30**, placing it in his palm, between his fingers, or on a tabletop, and then using container cap **22** as described above, while removed from container receptacle **28** or attached thereto, to illuminate medicinal product **30**.

FIGS. 10 through 15 illustrate a second embodiment of a medicine container, generally **100**, embodying a container cap, generally **102**. Medicine container **100** also includes a container receptacle **28** and a container label **32**, both preferably identical to those described in detail above.

Container cap **102** is comprised of an annular supporting structure **144** having a cavity **148** into which is fitted a printed circuit board **120**. Thus, printed circuit board **120** is contained within container cap **102** and is preferably positioned perpendicular to the longitudinal axis of attached container receptacle **28**. Printed circuit board **120** is secured in cavity **148** to annular supporting structure **144**, preferably by adhesive **61**, such as AS-124M removable adhesive, available from Adhesives Research, Inc., although other securing methods may be used. Annular supporting structure **144** also contains an annular receiving ledge **116** to accept container cap insert cover **24**. Container cap insert cover **24** is connected to annular supporting structure **144** at annular receiving ledge **116** either by a frictional fit or by an adhesive, e.g., silicone rubber. Container cap insert cover **24** also contains flexible membrane **46**, preferably identical to that described

in detail above, which makes direct contact with electrical switch **52**, e.g., a Panasonic EVQ-PLDA15. Container cap **102** also contains a plurality of annularly arranged openings **108** from which a plurality of lightwaves **104** emerge. The lightwaves **104** are generated by a plurality of illuminating sources **128**, e.g., a blue light emitting diode, such as a Lumex SSL-LX3044USBC, although other LEDs, emitting other colors, or incandescent bulbs, such as a Copeland retinoscope lamp bulb, may be used. Annular supporting structure **144** is preferably fabricated by molding an opaque plastic material, such as colored Acrylic or colored Lexan. Additionally, annular supporting structure **144** can be machined from plastic stock (e.g., cast Acrylic rod).

Lightwaves **104** travel through a plurality of filter covers **110** to create a plurality of light source beams **106**, which illuminate container label **32**. Similar to the preferred embodiment discussed above, filter covers **110** may be manufactured with different colors depending on the color of the LED used. For example, filter covers **110** can be made from a blue-colored material to produce a bluish illumination if illuminating source **128** is a white LED. In fact, there are a wide variety of LED/filter combinations that can be used to

create many light beams colors. Further, colored LED lens covers, e.g., a Chicago Miniature Lamp 434-6, can be used, which snap directly onto the LED itself, thus offering yet another method for achieving various illumination colors. Thus, there are a number of possibilities for creating various illumination colors. Filter covers **110** also provide environmental protection, e.g., waterproofing, for the internal components of container cap **102**. Annular supporting structure **144** has a set of internal threads **64** for attachment to a set of external threads **66** in container receptacle **28**.

Printed circuit board **120** contains energy source **56**, e.g., a Duracell D361, a variable current-limiting device **112**, e.g., a Bourns Series 3309P, a plurality of illuminating sources **128**, connected by a plurality of illuminating source leads **124**, and electrical switch **52**, all connected by PCB circuit traces in order to implement the closed circuit shown in FIG. 15. In the second embodiment four illuminating sources **128** are used, however, more or less illuminating sources **128** could be used to generate lightwaves **104**. These circuit components can be inserted on printed circuit board **120** in an automated fashion (automatic insertion manufacturing typical to the electronics industry) or by manual methods. Alternatively,

the closed circuit can be implemented by soldering the components together directly, without the use of printed circuit board **120**, and subsequently securing the components in cavity **148** by an encapsulating potting compound, e.g., EPOCAP 14530A/2404B, available from Sanford Distributing Co., or a flexible adhesive, such as silicone rubber, e.g., Silastic® silicone rubber, available from Dow Corning.

The second embodiment of the invention shown in FIGS. 10 through 15 utilizes the same functional principles as those described in the preferred embodiment above, but operates in a slightly different manner. The individual holds medicine container **100** in such a way that at least one digit of the individual's hand, preferably the forefinger, rests on flexible membrane **46**. While reading container label **32**, the individual presses flexible membrane **46** thus directly contacting electrical switch **52**. As switch **52** closes, an electrical current **152** flows from energy source **56** through variable current-limiting device **112** and divides into a plurality of smaller electrical currents **132**. Each of smaller electrical currents **132** flow through respective illuminating sources **128**, and eventually combine to return back to energy source **56**. As smaller electrical currents **132** flow through

each illuminating source **128**, each illuminating source **128** is energized and lightwaves **104** are emitted and travel through filter covers **110** to form light source beams **106**. Variable current-limiting device **112** can be adjusted to vary the intensity of lightwaves **104**. Light source beams **106** overlap in such a way that container label **32** is illuminated in its entirety. The individual may then read container label **32** in a variety of ways as described above in the preferred embodiment.

FIG. 16 illustrates a third embodiment of a medicine container, generally **200**, embodying a container cap, generally **204**. Medicine container **200** also includes a container receptacle **28** and a container label **32**, both preferably identical to those described in detail above. In this embodiment electrical switch **52** has been moved to the side of container cap **204** just beneath a side-mounted flexible membrane material **212** attached to a container cap side **214**. A container cap insert cover **208** is connected to container cap **204** either by a frictional fit or by an adhesive, e.g., silicone rubber. Container cap **204** has internal structure, similar to that described in detail above, in order to enclose

and support the appropriate printed circuit board and components.

The third embodiment of the invention shown in FIG. 16 utilizes the same functional principles as above, but operates in a slightly different manner. The individual holds medicine container **200** in such a way that at least one digit of his hand, preferably his thumb, rests on side-mounted flexible membrane **212**. While reading container label **32**, the individual presses flexible membrane **212** thus directly contacting electrical switch **52** just beneath. As electrical switch **52** closes, electrical current flows from energy source **56** and energizes the LEDs as described above (either the single LED of the preferred embodiment or the plurality of LEDs of the second embodiment). The individual may then read container label **32** or inspect medicinal product **30** in a variety of ways as described above in the preferred embodiment.

FIG. 17 illustrates a fourth embodiment of the invention, which provides a different method for activating the switch mechanism. In this embodiment a flexible container cap insert cover **216**, preferably constructed entirely from a thin plastic or rubber material, is used to make contact with electrical

switch **52** either directly, or indirectly through cylindrical adaptor **80**. Flexible container cap insert cover **216** is connected to outer annular support rim **70** in the preferred embodiment, or to annular supporting structure **144** in the second embodiment, by a frictional fit (or by an adhesive, e.g., silicone rubber or AS-124M removable adhesive, available from Adhesives Research, Inc.).

In the fourth embodiment shown in FIG. 17 the individual holds medicine container **20** in such a way that at least one digit of his hand, preferably his forefinger, rests on flexible container cap insert cover **216**. While reading container label **32**, the individual presses flexible container cap insert cover **216** thus contacting cylindrical adaptor **80**, which in turn contacts electrical switch **52** (FIG. 2), or by directly contacting the switch when cap insert cover **216** is used in the second embodiment shown in FIG. 11. The individual may then read container label **32** or inspect medicinal product **30** in a variety of ways as described above in the preferred embodiment.

FIG. 18 illustrates a fifth embodiment of the invention whereby illumination source **40** is energized using a monostable

multivibrator **310**, e.g., a National Semiconductor LMC555CM, although other timer circuitry may be implemented. In this mode, a monostable pulse output **314**, in the ON state, energizes illumination source **40**. Illumination source **40** remains energized for a preset period of time, T, generally **318**, thus ensuring that the LED is de-energized after a certain amount of time, further conserving energy source lifetime. Monostable multivibrator **310**, illumination source **40**, energy source **56**, and electrical switch **52** can all be mounted on a printed circuit board similar to that described in the preferred embodiment above. Monostable multivibrator **310** can also energize illuminating sources **128** if used in the second embodiment described above.

The fifth embodiment shown in FIG. 18 operates to conserve the energy contained in energy source **56**, thus prolonging its lifetime. The multivibrator circuit shown operates in a monostable, or "one-shot," mode. When switch **52** is pressed then released, monostable multivibrator **310** outputs a preset timed pulse just long enough for the individual to read container label **32**, e.g., 15-20 seconds, although other times may be programmed. Monostable pulse output **314** energizes illumination source **40** for preset period of time, T **318**.

Energized illumination source **40** in turn illuminates container label **32** as described above. Once preset period of time, T **318** is complete, monostable pulse output **314** de-energizes illumination source **40** thus stopping a monostable pulse output electrical current flow **322** and conserving energy source **56**. The individual may energize illumination source **40** again by pressing then releasing switch **52**. This approach may also function with the second embodiment shown in FIGS. 10-15, whereby all four illuminating sources **128** would be energized by monostable pulse output **314**.

As described in FIG. 19, in a sixth embodiment, an astable multivibrator circuit **300**, e.g., a National Semiconductor LMC555CM, although other timer circuitry may be implemented, can be used to energize illumination source **40** by turning it ON and OFF very rapidly. This has the dual effect of reducing the current illumination source **40** draws while energized, thus prolonging energy source **56** lifetime, while also changing the brightness of illumination source **40** by varying the voltage supplied to illumination source **40**. Both of these features are accomplished by changing the duty cycle [T(on) / T(off)] of periodic pulse train, generally **304**, output from astable

multivibrator circuit **300**. The maximum brightness, and maximum electrical current drain from energy source **56**, occur when T(on) = T(off). Brightness and electrical current drain decrease as T(on) decreases and T(off) increases. Illumination will appear to be "ON" to the patient, e.g., not visibly flickering, as long as the frequency of the pulse train remains above approximately 60-Hz. Astable multivibrator circuit **300**, illumination source **40**, energy source **56**, and electrical switch **52** can all be mounted on a printed circuit board similar to that described in the preferred embodiment above. Astable multivibrator circuit **300** can also energize illuminating sources **128** if used in the second embodiment described above.

The sixth embodiment shown in FIG. 19 operates to further conserve the energy contained in energy source **56**, thus prolonging its lifetime. The multivibrator circuit shown operates in an astable mode, or "free-running" mode. When switch **52** is pressed and held closed, astable multivibrator circuit **300** outputs preset periodic pulse train **304**. Periodic pulse train **304** presents a high state [T(off)] and a low state [T(on)] as shown in FIG. 19. In this embodiment, a low state energizes illumination source **40** while a high state de-

energizes illumination source **40**. In such a configuration, the average voltage delivered to illumination source **40** depends on the duty cycle, with no power dissipation during the OFF periods [T(off)] (e.g., no energy source electrical current drain). Astable multivibrator circuit **300** can be used to deliver a duty cycle from 50% to 99%. By using the LOW period [T(on)] of periodic pulse train **304** to power illumination source **40**, and setting a 50% duty cycle [T(on) = T(off)] as the maximum brightness (and maximum energy source electrical current drain), one can control the illumination source **40** brightness and electrical current drain from virtually OFF (99% duty cycle) to a maximum ON (50% duty cycle). Periodic pulse train **304** of astable multivibrator circuit **300** energizes illumination source **40** with an astable output electrical current flow **326**, which in turn illuminates container label **32** as described before. This approach may also function with the second embodiment shown in FIGS. 10-15, whereby periodic pulse train **304** would energize all four illuminating sources **128**.

FIG. 20 illustrates a seventh embodiment which combines monostable multivibrator **310** with astable multivibrator circuit **300**. In this case a dual-timer integrated circuit, such as a National Semiconductor LM556CMXTR, may be used,

1 although other timer circuitry may be implemented. Monostable
2 multivibrator **310**, astable multivibrator circuit **300**,
3 illumination source **40**, energy source **56**, and electrical
4 switch **52** can all be mounted on a printed circuit board
5 similar to that described in the preferred embodiment above.
6 Monostable multivibrator **310** and astable multivibrator circuit
7 **300** can also energize illuminating sources **128** if used in the
8 second embodiment described above.
9
10 The seventh embodiment shown in FIG. 20 operates to
11 further conserve the energy contained in energy source **56**,
12 thus prolonging its lifetime even further. When switch **52** is
13 pressed then released, monostable multivibrator **310** outputs a
14 preset timed pulse just long enough for the individual to read
15 the container label **32**, e.g., 15-20 seconds, although other
16 times may be programmed. In this embodiment monostable pulse
17 output **314** is used to activate astable multivibrator circuit
18 **300**, which in turn energizes illumination source **40** with
19 periodic pulse train **304** as described above. Energized
20 illumination source **40** in turn illuminates container label **32**
21 as described before. Illumination source **40** is energized for
22 preset period of time, T **318**. Once preset period of time, T

318 is complete, monostable pulse output 314 de-activates astable multivibrator circuit 300 thus stopping astable output electrical current flow 326 and conserving energy source 56. The individual may energize illumination source 40 again by pressing then releasing switch 52. This approach may also function with the second embodiment shown in FIGS. 10-15, whereby periodic pulse train 304 would energize all four illuminating sources 128.

FIGS. 21 and 22 illustrate an eighth embodiment of the invention using a medicine container, generally 400, embodying a container cap, generally 404, a conventional container cap 408, and container label 32 attached to container receptacle 28, both preferably identical to those described in detail above. In this embodiment container cap 404 is removably coupled to conventional container cap 408. Container cap 404 is similar to container caps 22, 102, 204 described above with respect to illumination and control of illumination, but the structure used for attachment to container receptacle 28 is adapted to allow container caps 22, 102, 204 to attach directly to conventional container caps 408, which are currently supplied with medicine containers. That is,

container cap **404** is removably connected to conventional container cap **408** at junction **416** by a frictional fit or by an adhesive, e.g., silicone rubber or AS-124M removable adhesive, available from Adhesives Research, Inc.

The eighth embodiment of the invention shown in FIGS. 21 and 22 utilizes the same principle as above, but operates in a slightly different manner. In reading container label **32** and inspecting medicinal product **30** contained within container receptacle **28**, the individual retrieves medicine container **400** and then attaches container cap **404** directly to conventional container cap **408**. The individual does so by initially aligning container cap **404** to conventional container cap **408**, as shown in FIG 22, and then pushing container cap **404** until it is firmly seated on conventional container cap **408**, as shown in FIG. 21. The individual may then read container label **32** or inspect medicinal product **30** using light source beams, generally **412**, in a variety of ways as preferably described in the above embodiments.

FIGS. 23 and 24 illustrate a ninth embodiment of the invention using a medicine container, generally **500**, embodying an illumination base, generally **502**, and container label **32**

attached to container receptacle **28**, both preferably identical to those described in detail above. In this embodiment medicine container **500** is removably coupled to illumination base **502**. Illumination base **502** is larger than medicine container **500** and serves as a supporting base to hold medicine container **500** when medicine container **500** is inserted into an opening **506**, which contains a plurality of friction fingers **504** configured radially within illumination base **502**. Friction fingers **504** are formed from a moldable flexible material, such as silicone rubber, and serve to press against medicine container **500** (see Fig. 24B) therefore holding it in place when medicine container **500** is placed in illumination base **502**. Illumination of container label **32** occurs when a plurality of light source beams **512** are emitted from an annular output opening **508**. Light source beams **512** are generated as described above using either a single LED **522** with a light pipe channel **518**, preferably made from acrylic as described above, or with a plurality of LEDs (not shown) directed from illumination base **502** toward container label **32**. Additionally, other light sources could be used to generate light source beams **512**.

The ninth embodiment of the invention shown in FIGS. 23 and 24 utilizes the same principle as above, but operates in a slightly different manner. In reading container label **32** and inspecting medicinal product **30** contained within container receptacle **28**, the individual retrieves medicine container **500** and then inserts it in opening **506** in illumination base **502** through friction fingers **504**. As medicine container **500** contacts an electrical switch **516** within the base **502**, just under friction fingers **504**, LED **522** is energized and emits light source beams **512**, which travel through light pipe channel **518** where they are directed to label **32**. The individual may then read container label **32** or inspect medicinal product **30** using light source beams **512**.

FIGS. 25 and 26 illustrate a tenth embodiment of the invention using a medicine container, generally **600**, embodying an illumination base, generally **602**, and container label **32** attached to container receptacle **28**, both preferably identical to those described in detail above. In this embodiment medicine container **600** is removably coupled to illumination base **602**. Illumination base **602** further consists of a supporting base **620** and an enclosing container illumination

lightpipe **616**, which is larger than medicine container **600** and aligns with an output aperture **608**. Lightpipe **616** is preferably circular and made from acrylic, as described in the above embodiments. Lightpipe **616** could also be constructed in another shape, such as rectangular or square, as long as output opening **608** is of a similar configuration. Supporting base **620** serves as a supporting base to hold medicine container **600** when medicine container **600** is inserted into an opening **606**, which contains a plurality of friction fingers **604**. Friction fingers **604** are formed from a flexible material, such as silicone rubber, and serve to press against medicine container **600** therefore holding it in place when medicine container **600** is placed in supporting base **620**. Illumination of container label **32** occurs when a plurality of light source beams **612** are emitted from an annular output opening **608** and travel through lightpipe **616** to label **32**. Light source beams **612** are generated as described above using either a single LED with a light pipe channel (not shown), or with a plurality of LEDs (not shown) directed from supporting base **620** toward container label **32**. Additionally, other light sources could be used to generate light source beams **612**.

The tenth embodiment of the invention shown in FIGS. 25 and 26 utilizes the same principle as above, but operates in a slightly different manner. In reading container label **32** and inspecting medicinal product **30** contained within container receptacle **28**, the individual retrieves medicine container **600** and then inserts it in enclosing container illumination lightpipe **616** until it engages friction fingers **604** within opening **606**. As medicine container **600** contacts an electrical switch **516** (not shown) within the base **620**, just under friction fingers **604**, the LED is energized and emits light source beams **612**, which travel through light pipe channel **616** where they are directed to label **32**. The individual may then read container label **32** or inspect medicinal product **30** using light source beams **612**.

There have been described and illustrated herein embodiments of a self-contained illumination cap for medicine containers and methods for using the same. While particular embodiments of the invention have been described, it is not intended that the invention be limited thereto, as it is intended that the invention be as broad in scope as the art will allow and that the specification be read likewise. Thus, it is recognized that although the container cap is shown

connected to the medicine container receptacle by threads, thus signifying a typical, adult-type cap, with a screw-on, screw-off action, other types of connections will work as well. In particular, the container cap can be designed as a childproof or child resistant cap, e.g., those types that have to be further manipulated in some fashion before being removed; as an adult cap that simply snaps off or pulls off of the medicine container receptacle; or as a universal cap (e.g., such as one using o-rings to provide a frictional fit) that fits a wide variety of containers and/or conventional container caps. In other words, there are a number of attachment methods that may be implemented.

It is also recognized that although the light beams are created by an LED, other illumination sources may be used as well, such as incandescent bulbs, electroluminescent sources, or fluorescent sources, to name a few. Additionally, although the preferred embodiment shows only one LED centered in the container cap, more than one LED could be used to provide lightwaves to the light pipe channel. Also, although the second embodiment shows multiple LEDs used to illuminate the label (four LEDs shown) in a complete 360-degree range, the device can function with as few as one LED, that is, such

illumination can be less dispersed. In this case, the container cap can be rotated through 360-degrees to read a label that completely encompasses the container.

It is further recognized that although the preferred embodiments describe a current-limiting device, such as a resistor or potentiometer, to limit electrical current delivered from the energy source to the illumination source, other illumination sources with built-in current limiting capabilities may be used, thus negating the use for a discrete current-limiting device (e.g., such as an LED with an internal resistor). Additionally, the energy source and illumination source may be chosen in such a way that there is no need for a current-limiting device (e.g., the battery voltage is just enough to supply the voltage required by the illumination source).

It is even further recognized that although the preferred embodiment describes a light guide constructed using the material inherent to the cap, other types of light delivery devices may be used as well, such as individual optical fibers or individual light pipes (e.g., acrylic plastic or liquid) designed to fit within the container cap. Additionally,

although the light pipe channel of the preferred embodiment is shown with a flat entry surface, a curved entry surface can be constructed which acts to gather more light from the illumination source into the light pipe channel. Even further, a curved exit surface can be constructed which acts to focus more of the light to the label. Additionally, even though the annular filter cover is shown with a flat surface, a curved exit surface can be constructed which acts to focus more of the light to the label.

It is also understood that although the energy source is shown as a silver-oxide button cell, other battery-type energy sources may be used as well, such as mercury-oxide cells, lithium cells, lithium manganese dioxide, or zinc-air cells, to name a few. It is also conceivable that other sources of energy may be used to energize the LED. These include solar cells with some type of energy storage medium (such as a capacitor), fuel cells, or magneto-electric whereby energy is generated by motion and stored in some type of energy storage medium (e.g., a capacitor).

It is further understood that although the switch presented above to energize the illumination source is a

manufactured, packaged switch, discrete switches made from individual parts (such as separate metal spring strips attached to the printed circuit boards) could be used as well. Additionally, although metal contact switches are presented, other switching mechanisms, such as liquid mercury tilt switches could be used. Further, although the switch is shown directly beneath the LED in the above embodiments, it could be placed in another location on the PCB. Even further, the switch mechanism could be placed within the outer walls of the cap, such that the patient could squeeze the cap anywhere along its sides to energize the illumination sources (e.g., a pair of metal strips can be designed within a flexible cap wall such that when the wall is squeezed, an outside circular metal strip would contact an inner circular metal switch thus connecting the energy source to the illumination source). That is, there are a number of possible construction methods and locations of devices that can be used to energize the illumination sources.

It is even further recognized that there are additional circuits, both discrete and integrated (ICs), that can perform equivalently to the monostable and astable multivibrator functions, that is, to conserve energy source lifetime and

control LED brightness. Additionally, although surface mount components are described in the above embodiments, it is noted that more traditional, non-surface mount devices may be used as well.

It is even further understood, that although the current embodiments are shown with a flat flexible membrane, a raised or curved membrane could also be used. Additionally, although shown with a smooth surface, the top surface of the flexible membrane can also be manufactured with texture, such as raised lines or a raised cross-hatched pattern, providing further ease in using the device in low-light conditions.

It is additionally recognized that although the illumination base of the ninth and tenth embodiments is shown with a square shape, other shapes, such as circular, oval, rectangular, hexagonal, etc. could be utilized as well. Even further, although the opening that accepts the medicine container is shown as being circular, it could also be of a variety of shapes, such as oval, square, rectangular, hexagonal, etc. That is, there are a number of variations for the base construction with respect to its shape and opening. Additionally, although radial friction fingers, which hold the

medicine container in the base, are shown, other configurations of friction fingers could be used, such as a plurality of fingers arranged in a parallel fashion to each other. It is also recognized that although only one opening is shown in the illumination base, there could be a plurality of openings with accompanying illumination means for each, such that a number of containers could be viewed simultaneously. Further, although an internal electrical switch is shown and used to energize the illumination sources, it is recognized that an external switch, mounted on the top surface or side surface of the illumination base, may also be used to energize the illumination sources. Even further, although an electrical switch is shown, it is recognized that an electro-optical switch mechanism could be implemented such that when the container is inserted in one of the illumination base openings, the container body interacts with the electro-optical switch such that the illumination sources are energized.

It will also be appreciated by those skilled in the art that yet other modifications could be made to the provided invention without deviating from its spirit and scope as claimed. As such, those skilled in the art will appreciate

that the conception, upon which this disclosure is based, may readily be utilized as a basis for the designing of other structures, methods and systems carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent construction insofar as they do not depart from the spirit and scope of the present invention.